

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	<ul style="list-style-type: none"> Initial p.d. across the capacitor is zero Or Initial p.d. across bulb will be 1.5 V/maximum Or initial current is maximum (1) Bulb will be bright/lit initially (1) As capacitor charges the brightness of bulb decreases (1) Exponential decrease Or The time constant is 6.0 s (so the process will be of the order of 25 – 35 s) (1) 	Accept pd across capacitor increasing so brightness of bulb decreases MP4 for correct calculation of time constant <u>Example of calculation</u> $RC = 5.0 \Omega \times 1.2 F = 6.0 s$	4

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to the following points: Observation 1 <ul style="list-style-type: none"> (the fraction of alpha scattering is less for aluminium) so the force of repulsion is less (at a given distance) (1) therefore the charge on an aluminium nucleus is less than on gold nucleus (1) Observation 2 <ul style="list-style-type: none"> (the E_k is less for scattered alpha for aluminium) so recoiling nucleus must have some/more kinetic energy (1) The mass of an aluminium nucleus is less than mass of a gold nucleus (1) 		4

Q3.

Question Number	Answer	Additional guidance	Mark
(a)(i)	thermionic emission		(1)

Question Number	Acceptable Answer	Additional guidance	Mark
(a)(ii)	<ul style="list-style-type: none"> equate $\frac{1}{2}mv^2$ and VQ (1) $v = 2.3 \times 10^7 \text{ m s}^{-1}$ (1) 	<p><u>Example of calculation:</u> $E = 1500 \text{ V} \times 1.6 \times 10^{-19} \text{ C} = 2.4 \times 10^{-16} \text{ J}$</p> $v = \sqrt{\frac{2 \times 2.4 \times 10^{-16} \text{ J}}{9.11 \times 10^{-31} \text{ kg}}} = 2.3 \times 10^7 \text{ m s}^{-1}$	(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(i)	<ul style="list-style-type: none"> use of $F = EQ$ and $E = \frac{V}{d}$ (1) <u>OR</u> see $F = \frac{VQ}{d}$ equate $F = ma$ and $F = EQ$ (1) 		(2)

Question Number	Acceptable Answer	Additional guidance	Mark
(b)(ii)	<ul style="list-style-type: none"> • use of speed = distance/time (1) • $t = 8.7 \times 10^{-10}$ (s) (1) • use of $a = \frac{vQ}{dm}$ (1) • use of $s = ut + \frac{1}{2}at^2$ (1) with $u = 0$ and vertical acceleration to find s • $s = 3.3 \times 10^{-4}$ m (1) 	<p><u>Example of calculation:</u></p> $t = \frac{0.02 \text{ m}}{2.3 \times 10^7 \text{ m s}^{-1}} = 8.7 \times 10^{-10} \text{ s}$ $s = \frac{1}{2} \times \left(\frac{50 \text{ V} \times 1.6 \times 10^{-19} \text{ C}}{0.01 \text{ m} \times 9.11 \times 10^{-31} \text{ kg}} \right) \times (8.7 \times 10^{-10} \text{ s})^2$ $s = 3.3 \times 10^{-4} \text{ m}$	(6)

Question Number	Acceptable Answer	Additional guidance	Mark
(c)	<ul style="list-style-type: none"> • use of $V = V_0 / \sqrt{2}$ (1) • vertical line (1) • positive and negative deflection shown (1) • maximum deflection 75 V (1) 	<p><u>Example of calculation:</u></p> $V_0 = 53 \text{ V} \times \sqrt{2} = 75 \text{ V}$	(4)